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Developing maturity model for transnational living lab collaboration

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Abstract: The idea for transnational living lab collaboration network has been proposed well over decade ago. Despite of a few random studies, theoretical models describing such a network does not yet exist. The aim of this study is to conceptualize a multi-factor maturity model for describing and defining the degree of collaboration maturity among two or more living labs from different countries. The drivers and obstacles for transnational collaboration were identified and Transnational Living Lab Collaboration Maturity Model (TLLCMM) was co-created by living labs from seven different countries including following four-stages: Network, Coordinated network, Cooperation and Collaboration. The suggested TLLCMM consists the following main factors: "Environment", "Membership", "Structure-Process", "Communication", "Purpose: Goal-Vision", and "Resources". For each factor and sub factor, corresponding maturity levels description were define.

Keywords: living lab, maturity model, transnational, cross-border, collaboration, cooperation, innovation, network, health and wellbeing

1 Introduction

Globalization of healthcare and wellbeing technologies, services, and marketplace has taken place in many different levels and forms (Chanda, 2000). As a result, there is an increasing need to develop innovative solutions, which from the start are ready for global markets as well as scale-up existing domestic solutions to global markets (Archibugi and Iammarino, 2002). According to European Network of Living Labs (ENoLL), living labs

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are grounded on multi-stakeholder participation and active user involvement, which in real-life setting are utilizing multi-method approaches while co-creating novel solutions across the different innovation process stages. The Helsinki Manifesto (Finnish, E.U., 2006) set an ambitious target for the transnational living lab collaboration to harmonise and standardise the business processes and data exchange models of the living lab participants. The aim has been discussed in conjunction to the European policies, but in spite of the obvious need (Bódi et al., 2015), such an evidence based governance and action model for harmonised and standardised transnational living lab collaboration does not yet exist. To support the Helsinki Manifesto and transnational living lab movement, the aim of this study is to conceptualize a multi-factor maturity model for describing and defining the degree of collaboration maturity among two or more living labs from different countries.

2 Prior research on transnational collaboration and maturity models

2.1 What is a transnational living lab network?

The idea of a living lab approach was introduced in the early-2000s in context of future housing and since then it has been adopted in various other domains, especially in health & wellbeing and smart cities context (Leminen et al. 2017). In terms of scientific maturity, living lab as a concept is still relatively infancy and various definitions and rivalling terms have been suggested (Santonen, 2018). According to Santonen and Julin (2019a) "*a living lab as user-centered research and open innovation approach operates in a real-life or real-life kind of environments in which diverse groups actors are together developing and/or testing in a co-creative manner new solutions at different stages of innovation process while utilizing various research, development and testing methods via systematic methodology"*. "Transnational" by dictionary definition means an activity "that exist or take place in more than one country". Thus, a transnational living lab network by definition should consist collaboration among a group of living labs located and operating in more than one country. Alternatively, also cross-border living lab term has been used to describe similar concept (Schaffers and Turkama, 2012). Basically the definition for cross-border innovation system such as living lab is very similar – a system between actors being divided by national (or regional) border. For the sake of clarity, only transnational living lab term is used thereafter to refer the both terms.

2.2 Prior research findings transnational living lab and cross-border innovation networks and systems

Prior studies on the transnational living lab topic are very limited, but have defined different tasks for the stakeholder (Haho and Kaartti, 2018), proposed system requirements and identified various challenges and benefits (Lievens et al., 2011; Nina et al., 2014), and suggested transnational services for supporting SMEs internationalization efforts (Santonen and Julin, 2019a). Many barriers have been identified for transnational living lab collaboration which might explain the low adoption level. Among the identified barriers are different societal backgrounds, strategies and policies as well as problems in coordination mechanisms and funding (Lepik and Krigul, 2014). Developing and scaling up living lab activities to a transnational level appears to be a stepwise process in which the maturity of the transnational collaboration among the key stakeholders gradually

increases (e.g. Schaffers and Turkama, 2012). Since the prior research findings are limited, additional insights for transnational collaboration were also looked from general innovation management literature.

The studies focusing on cross-border (open) innovation systems in general are also limited, while there are lot of studies on how development teams in multinational corporations innovate (e.g. Ghoshal and Bartlett, 1988; Nobel and Birkinshaw, 1998; Subramaniam, 2006). Since the unit of analysis in this study is a living lab, grounded on multi-stakeholder quadruple collaboration in an open innovation environment, the discussion on multinational corporations is omitted.

In most cases living labs are tightly rooted into local and regional innovation networks and ecosystems. When developing transnational collaboration in such setting, it is important to knowledge that different geographical areas and Regional Innovation Systems (RIS) can differ greatly in terms of their innovation capabilities (Hollanders et al. 2019). Regions also possess different kinds of competitive advantages, which in Europe are the foundation for smart specialization strategy (European Commission, 2014). Therefore, the regional and local conditions, focus areas and capabilities to innovate have great impact on the transnational living lab collaboration (Trippl, 2006).

However, geographical proximity alone is not enough to explain the success or failure of cross-border collaboration (Hansen, 2015). One should also consider also the impact of cognitive, organizational, social, and institutional proximity (Boschma, 2005). Also Trippl (2006) listed a group factors hindering and favouring the development of cross-border innovation networks and suggested following policy action to overcome the barriers: (1) highlighting the importance of cross-border collaboration, (2) building an identify, (3) stimulating knowledge interactions, (4) supporting cross-border clusters, (5) creating intermediary / bridging organization to facilitate collaboration, and (6) promoting multi-actor governance. Conceptual models including underlying factors such as network properties, knowledge flows and availability of resources have been proposed to explain the cross-border innovation networks operations (Platonov, and Bergman, 2011; Kiryushin et al., 2013). According to Ma et al. (2014) the suggested benefits of cross-border collaboration includes (1) access to complementary resources, (2) organizational capabilities and learning development, (3) supporting entering into new markets, (4) reduction of risks and bridging the structural holes in national networks.

Finally, it is highlighted that transnational living lab network is partially grounded coopetition (collaboration between competing organizations), since public funding is the main revenue source for living labs (Santonen and Julin, 2019b). In the case of public funding tendering process such as H2020 or national equivalents, there are typically more applicant than money available. Thus, in some funding calls living labs can be competitors or collaborators depending on the project consortium composition. According to Ritala (2012), coopetition is beneficial since in certain cases it (1) creating helps larger market and interoperable offering for customers, (2) improves competitive position against rival networks, and (3) helps creating more valuable and innovative solutions. Due these reasons the coopetition viewpoint in transnational living lab collaboration is very important, since living lab approach is generally not well known but especially weakly known among SMEs.

2.3 About maturity models in context of network collaboration

The process maturity and maturity level definitions (e.g. Humphrey, 1987; Paulk, 2002; OMG, 2008) were modified for our research purposes as follows:

> *"Maturity is the extent, which transnational collaboration processes are explicitly defined, measured, controlled and effective, whereas maturity-level is a well-defined evolutionary plateau serving as stepping stone for achieving a next maturity level ending up to mature transnational living lab collaboration culture"*.

Rich streams of theoretical models for describing a business process maturity models (BPMMs) in various contexts have been presented (Van Looy, et al. 2011) and decision making tool has been proposed to selected the right model (Van Looy et al. 2013). Nevertheless, none of these models have been applied in a living lab context.

Typically BPMMs are grounded on descriptive approach and are helping to understand the current situation rather than having prescriptive goal to give guidance how to proceed to the higher maturity level (Tarhan et al. 2016). Basically, BPMM is defining a step-by-step roadmap without practical support how to get there. However, it is argued maturity model discussion tools are needed when co-creating transnational living lab collaboration model, since the business model among the living labs are different and therefore operators might have difficulties to understand each other (Santonen and Julin, 2019b).

3 Research design

De Bruin et al (2005) six step model (i.e. scope-design-populate-test-deploy-maintain) was adopted as a theoretical framework for developing maturity models as follows, while utilizing the mixed methods research approach (Johnson et al. 2007).

Scope phase. The maturity model concept was developed as a part of EU Interreg Baltic Sea Region programme 2014-2020 funded Product Validation in Health (ProVaHealth) – project between October 2017 to March 2020. The project stimulated collaboration between fifteen health and wellbeing living labs from eight different countries across the Baltic Sea region in order to support SMEs internationalization efforts by enabling them a smoother access to living lab services (note: one living lab withdrew during the project, resulting 14 living labs and seven countries at the end of the project).

Design phase A systematic literature review presented in section 2 was conducted covering transnational Living Lab and cross-border innovation network literature to define solid theoretical foundation. The review focused on identifying, and describing the internal and external target audiences, application methods and drivers, respondents and applications. The suggested Transnational Living Lab model is targeted for a group of Living Lab actors to perform a self-assessment in a co-creative manner when developing a shared vision for establishing transnational collaboration. Furthermore, the model can be used as a co-creation tool at the birth stage of innovation network or ecosystem, when the actor roles in the network are clarified and modularized (Moore, 2006; Dedehayir et al. 2018).

Populate and test phases: As pointed out prior, the domain specific literature provided only a faint starting point, thus the following iterative co-creation process was applied for the populating, testing and generating additional inputs for the model. Six thematically distinct workshops during a 2-year period were organized covering living lab services, end-

user engagement, business models, customers, activities and benefits realization. The drivers and obstacles for transnational collaboration were identified by asking the following open-ended questions from the project partners:

(Q1) What are the most important parts of a transnational cooperation?
(Q2) What added-value do you see for your own living lab?
(Q3) What obstacles do you see in transnational cooperation?
(Q4) What added-value do you see for the transnational cooperation?

The resulting open-ended answers (N=151) were harmonized into 26 survey questions in order to evaluate the relative importance of the different factors among the fourteen ProVaHealth-project partners. The survey utilized Quality Function Deployment (QFD) 0-1-3-9 scale (Franceschini and Rupil, 1999) to differentiate highly (9) /medium (3)-relevant variables more clearly, from non-relevant (0) /weakly (1) -relevant variables. The findings from survey as well as from workshops were analysed, summarized, iterated several times and used as input to understand how the diverse group of project partners understand and relate to the concept of a transnational living lab in context of regulated health and wellbeing domain. The survey and workshop results were used as input for the final co-creation workshop centred around the maturity model development consisting the key factors and sub factors and the corresponding maturity level descriptions for each factor. The workshop outcome consisting descriptions for all factors in different maturity levels in free wording format were analysed and harmonized. Finally, the resulting preliminary maturity model was distributed to all project partners for commenting and the final model was composed.

Deploy phase: The final model presented in this paper is acting as a dissemination tool. Further studies relating the limitations and improvements of the model ensure the maintenance of the model over time.

4 Results

4.1 Drivers and obstacles for transnational collaboration

In the Appendix Table 1, the mean and standard deviation values for perceived transnational cooperation importance, obstacles and added-value are presented. Friedman and Wilcoxon Signed-Ranks test were applied to evaluate, if variables relevance within each four main question groups differed. Even if minor mean value differences could be observed, a statistical difference between Q1.1 to Q4.7 variables were not detected excluding the following.

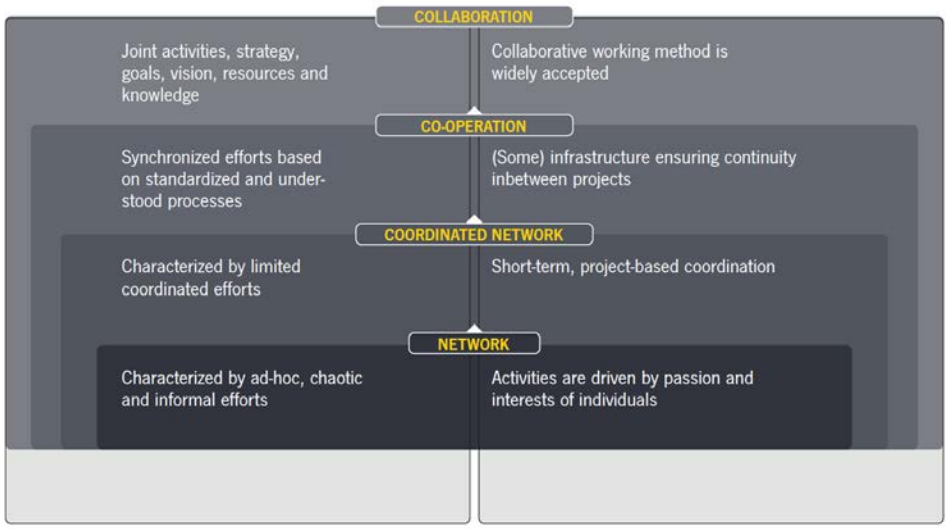
In the case of group Q1 "*what are the most important parts of a transnational cooperation?*" questions, Q1.1 *"Improvement and sharing of living lab services"* was considered more important than Q1.5 "*learning and benchmarking each other to improve the own living lab"*. Also both Q1.1 and Q1.2 "*Building up a reliable partner network*" were more important than Q1.5 "*Learning and benchmarking each other to improve the own living lab*". Group Q2 questions "*What added-value do you see for your own living lab?*" were all considered equally important.

In group Q3 questions "*What obstacles do you see in transnational cooperation?*", Q3.1 "*Regulation and business culture differences*" clearly stood out from the group, since its mean value was greater than Q3.4 "The international cooperation will cost more resources (time, money) and is actually not covered in the most cases", Q3.5 "*The interest of the involved SME's can be different and also the fear of competition can occur*", Q3.6 "*Lack of fast track market adaptation services*" and Q3.7 "*Language difficulties*". In all Q3.7 "*Language difficulties*" appeared to be most minor problem, since its mean value was observed to be less that that Q3.4 "*More costly / cost are not covered*" , Q3.5 "*SMEs having different interests / competition fear*" and Q3.6 "*Lack of "Fast track market adaptation" services*"

Regarding the final group of questions Q4 "*What added-value do you see for the transnational cooperation?*", it appeared that living labs are not in forefront seeking added-value for themselves via transnational collaboration. Growth of living lab was considered less important than Q4.1 "*Access to foreign market especially for the SME's*", Q4.2 "*Future (project) cooperation*" and Q4.3 "*Better access to knowledge*".

4.2 Transnational Living Lab Maturity Model (TLLMM) level definition

The co-created four-stage Transnational Living Lab Collaboration Maturity Model (later TLLCMM) modified from Camarinha-Matos and Afsarmanesh, (2008) is presented in Figure 1.



The NETWORK-level is characteristics by ad-hoc, chaotic and informal efforts, where activities are driven by limited amount of individuals and heroics who share the same interests and passion. The "COORDINATED NETWORK" is characteristics by limited amount of coordinated efforts, which are happening at project level and having relatively short-term scope (e.g. project duration). The "COOPERATION" is based on synchronized efforts, and well characterized, standardized, documented and understood processes. Continuity in-between project is ensured by having at least some joint infrastructure. The "COLLABORATION" is grounded on joint activities, strategy, goals, vision, resources

and knowledge in a network, which have clear identity collaborative working method is widely accepted among network members.

When applying the model in context of practical living lab operations, whose business models are mainly based on public project grants (Santonen and Julin, 2019b), the following interpretation are given for the different levels:

- NETWORK: Describing an informal network
- COORDINATED NETWORK: Describing a common project partnership
- COOPERATION: Describing a partnership where the partners have collaborated for some time in various projects and have built long-term trust which have reached a certain maturity
- COLLABORATION: Describing a very mature collaboration, often with a formed joint venture or similar

It should be noted that moving from one level to the next would most likely cost time, resources and energy to succeed. Therefore, this transformation is more dependent on external circumstances than everyday operations, needing more specific financial and policy support from all levels (i.e. local, regional, national and international) of policy makers. Likewise, it is equally possible to be at an "in-between" level, where some features from the next maturity level is in place but other are not, either by design, or by chance. This could be because of slow maturation of the partnership, unguided development, or being in domains with very specific constraints.

4.3 Transnational Living Lab Maturity Model (TLLCMM) factors

The theoretical framework for the TLLCMM main factors were adopted from Mattessich and Monsey (1992) six category model including following main factors: "Environment", "Membership", "Structure-Process", "Communication", "Purpose: Goal-Vision", and "Resources". For each factor and sub factor, corresponding maturity levels description were defined (Appendix Figure 1 and 2).

Environment: As pointed out previously, living labs are heavily depending on public funding, which availability is greatly depending on the political goodwill. Furthermore, living labs in ProVaHealth context were operating in strictly regulated healthcare domain. Unfortunately for transnational living lab approach, the public funding structures and regulations are different in different countries although some EU-level control and steering is existing. Furthermore, regulation and business culture differences were also highlighted as the greatest challenge for establishing transnational collaboration among living labs. Therefore, transnational living labs need strong and long-term support from all levels of policy makers including EU, national, regional and local levels. The living lab organization are often also tightly interlink to other public authorities by ownership (e.g. municipal or regional authority is shareholder of living lab organization). Thus, living lab own internal culture and environment should also be favourable for transnational collaboration. The maturity levels varies from "not adapted – partly adapted – regularly adapted – mostly adapted to transnational living lab need" and "no or very little – some short-term – adequate long-term – continuous support and promotion for transnational living lab mission".

Membership: The membership factor consist the partners (i.e. the member of the transnational network) and cost sharing among the network members. The partners membership evolves from "haphazard informal and free of charge network participation"

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to “short-term project grant and co-financing” coordinated network. The co-operation level is characteristics by “long-term” partnership where network participation includes membership fee. At the final stage, all previous cost sharing approaches are included but also a strategic agreement on the sharing of resources is made and partners are committed to the network membership.

Structure-Process: The third factor includes “conflict management”, “commitment-engagement” and “leadership” sub factors. At the first level conflict management, formal structure/commitment and leadership are non-existing. In the second level the leadership, conflict management and structure are short-term and inherited e.g. from on-going project practices. At the cooperation stage, formal long-term executive level cooperative management practices, are introduced. At the final stage, conflict management is operating proactively instead of reactively and formal strategic level collaboration supported by leadership board is operational.

Communication: Communication consist internal and external information and communication management. At the network level, communication is grounded on ad hoc operations and information management is non-existing. At the coordinated level some semi-structured and/or short-term information and communication sharing platforms and processes are available. At the cooperation level a single external contact point is available and formal long-term communication principles grounded on structured information are operationalized. Organised and managed information and communication strategy and platform is implemented.

Purpose: Goal-Vision: The maturity levels in purpose factor evolves from “no shared vision or goal” to “short-term goals and somewhat shared vision” (e.g. project goal and vision). At the third level cooperation is grounded on some jointly negotiated, accepted, shared and described goals and vision. Accepted and implemented shared goals with a common vision are guiding transnational activities at the collaboration level.

Resources: The final resource factor includes “knowledge”, and “human”, “technical” and “financial” resources, which at the network level are not shared. The coordinated network level requires short-term sharing of pre-defined resources and knowledge, which can be defined e.g. in the project plan. Cooperation level is based on structured sharing and re-using of knowledge and information. Limited resource sharing with long-term commitment is existing. At the collaboration level new knowledge is jointly co-created and co-produced. There is permanent joint human, technical, and financial resource pool, which is optimized for cross-organizational resource allocation.

5 Conclusions

The idea for transnational living lab collaboration network has been proposed well over decade ago. Despite of a few random studies, theoretical models describing such a network does not yet exist. To support the movement towards more intensified transnational collaboration, a multi-factor Transnational Living Lab Collaboration Maturity Model (TLLCMM) was conceptualized and the key drivers and obstacles for transnational living lab collaboration were identified.

The following drivers for transnational collaboration among living labs were consisted equally important and consisted (1) better and expanded visibility, marketing and network, (2) access to (other living labs) services, knowledge and technologies while learning from them and to further develop (own) living lab services to (3) gain more international

funding. “Regulation and business culture difference”, “different interests of living labs”, and “lack of understanding of competences of other living labs” were identified as the most critical obstacles for transnational collaboration.

The identified drivers and obstacles showed a surprising coherence across the topics in terms of value for Living Lab and what kind of needs and expectations SMEs have for using transnational LL services (Santonen and Julin, 2019). Thus, establishing transnational living lab network should please both the living lab service providers and customers. Furthermore, the findings are also in-line with suggestions regarding coopetition strategy (Ritala, 2012). So far living lab approach has not been able breach to mainstream and therefore all the efforts to expand the market demand are welcome. Transnational living lab network is suggested as effective approach for coopetition due ability to offer more “widespread resources and customer base” and “reduced risks and costs” beyond what individual living lab can have.

Especially the support from all level of policy makers are required to establish fully functional transnational living lab. Support could be grounded on direct support to transnational living labs, and/or indirect support where SMEs would receive vouchers or similar to be used for living lab services. Better knowledge of transnational living lab structures, factors and maturity should result also increased chances for funding. The three identified obstacles are all pointing towards “trust” as the main component. It is argued that the added-value of collaboration would over time overcome the possible trust issues, but in short-term collaboration, these obstacles needs to be carefully taken into account.

The proposed TLLCMM clarifies and defines steps on the way towards established transnational living lab network, but it can be also utilized to evaluate national or regional level living lab collaboration. The maturity model can operate as a reference point or baseline for those responsible for cross-sectoral and cross-border innovation and business actives. More successful collaboration is gained among various stakeholders when there is a better understanding how the identified factors influence on transnational innovation systems and what kinds of interlinks are existing between the different factors. Defining common goals via continuous improvement process becomes easier when there is shared vision of the next maturity level and necessary improvement areas. As a result, all the involved stakeholders and living lab customers such as SMEs would benefit from the faster scalability of innovation within the fragmented European market and globally. This could lead to unseen societal gains by offering fast track to market-proof new health and healthcare products, which evidently are needed as the recent pandemic COVID-19 crisis has globally demonstrated.

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Appendix:

Table 1: Drivers and obstacles for transnational collaboration (N=15)

Variable description	*Mean*	*Std.Dev.*
What are the most important parts of a transnational cooperation?		
Q1.1 Improvement and sharing of LL services	7.07	3.39
Q1.2 Building up a reliable partner network	5.60	3.38
Q1.3 Communication and marketing	5.20	3.78
Q1.4 Different market information	5.00	3.98
Q1.5 Learning and benchmarking to improve the own LL	4.67	3.29
Q1.6 Expanding the network	3.73	3.43
What added-value do you see for your own living lab?		
Q2.1 Increasing visibility and improve the marketing	5.67	3.81
Q2.2 Developing services and access to other services	5.60	3.38
Q2.3 Access to knowledge and technologies	5.33	3.66
Q2.4 Increasing international funding	4.67	3.77
Q2.5 Expand the own network	4.53	3.40
Q2.6 Learning from other LL	4.40	3.50
What obstacles do you see in transnational cooperation?		
Q3.1 Regulation and business culture differences	5.60	3.85
Q3.2 Different interests of the LLs	4.80	3.67
Q3.3 Lack of competence information of LLs & partners	4.50	3.61
Q3.4 More costly / cost are not covered	3.73	3.43
Q3.5 SMEs having different interests / competition fear	3.27	3.73
Q3.6 Lack of ”Fast track market adaptation” services	2.93	2.69
Q3.7 Language difficulties	2.07	2.96
What added-value do you see for the transnational cooperation?		
Q4.1 Access to foreign market especially for the SME’s	5.53	3.94
Q4.2 Future (project) cooperation	5.47	3.52
Q4.3 Better access to knowledge	4.93	3.56
Q4.4 Possibility for SMEs to scale and grow	4.87	3.64
Q4.5 Access to more and other user and expanding own network	4.53	3.40
Q4.6 Access to other services to offer	3.73	2.89
Q4.7 Growth of LL	3.20	3.23

Figure 1: TLLCMM Environment, Membership and Structure-Process factors

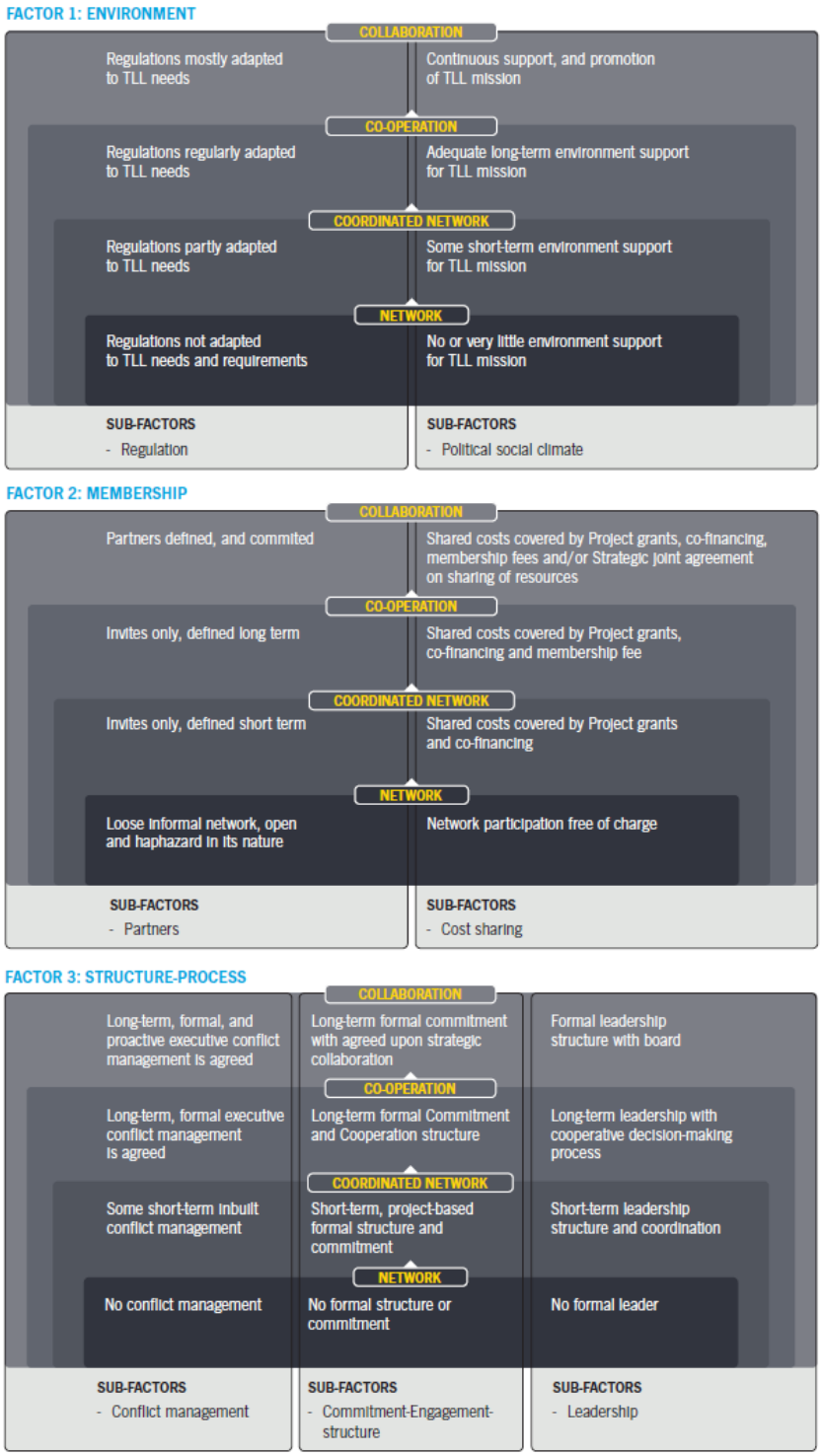

Figure 2: TLLCMM Communication, Purpose: Goal-Vision and Resources factors